



**10-A**  
**NOISE AND VIBRATION:**  
**TREATMENT PLANT**

**FINAL  
ENVIRONMENTAL  
IMPACT STATEMENT**

**Brightwater  
Regional Wastewater  
Treatment System**

**APPENDICES**

**Final**

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# **Appendix 10-A Noise and Vibration: Treatment Plant**

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**King County**

Department of Natural Resources and Parks  
**Wastewater Treatment Division**

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King County has prepared a Draft Environmental Impact Statement (Draft EIS) and Final Environmental Impact Statement (Final EIS) on the Brightwater Regional Wastewater Treatment System. The Final EIS is intended to provide decision-makers, regulatory agencies, and the public with information regarding the probable significant adverse impacts of the Brightwater proposal and identify alternatives and reasonable mitigation measures.

King County Executive Ron Sims has identified a preferred alternative, which is outlined in the Final EIS. This preferred alternative is for public information only, and is not intended in any way to prejudice the County's final decision, which will be made following the issuance of the Final EIS with accompanying technical appendices, comments on the Draft EIS and responses from King County, and additional supporting information. After issuance of the Final EIS, the King County Executive will select final locations for a treatment plant, marine outfall, and associated conveyances.

The County Executive authorized the preparation of a set of Technical Reports, in support of the Final EIS. These reports represent a substantial volume of additional investigation on the identified Brightwater alternatives, as appropriate, to identify probable significant adverse environmental impacts as required by the State Environmental Policy Act (SEPA). The collection of pertinent information and evaluation of impacts and mitigation measures on the Brightwater proposal is an ongoing process. The Final EIS incorporates this updated information and additional analysis of the probable significant adverse environmental impacts of the Brightwater alternatives, along with identification of reasonable mitigation measures. Additional evaluation will continue as part of meeting federal, state, and local permitting requirements.

Thus, the readers of this Technical Report should take into account the preliminary nature of the data contained herein, as well as the fact that new information relating to Brightwater may become available as the permit process gets underway. It is released at this time as part of King County's commitment to share information with the public as it is being developed.

## **1 AFFECTED ENVIRONMENT**

This TM addresses existing noise and vibration conditions at the proposed treatment plant sites. Noise is discussed first, followed by a description of vibration. Noise conditions at the treatment plant sites are characterized specifically.

### **1.1 Noise**

The human ear is sensitive to a wide range of sound intensities. The decibel (dB) scale used to describe sound is designed to account for the large range in audible sound intensities within a practical range of measurements. A change in sound pressure levels of 10 dB is roughly perceived as a halving or doubling of loudness. Hence, a 70-dB sound level will generally be judged to be twice as loud as a 60-dB sound level. People generally cannot detect differences of 1 dB, differences of 2 or 3 dB can be detected under ideal laboratory conditions, and a change of 5 dB is perceptible under normal conditions.

Because the human ear is not equally sensitive to all sound frequencies, instruments for measuring sound levels are designed to respond to or ignore certain frequencies. The frequency weighting most often used is A-weighting because it corresponds closely to human perception of loudness. Measurements from instruments using this system are reported in units of “A-weighted decibels,” or dBA. All noise levels in this TM are reported in dBA.

Normal conversation ranges between 55 and 65 dBA when the speakers are 3 to 6 feet apart. Quiet urban night-time noise dBAs range in the low 40s; noise levels during the day in a noisy urban area are frequently as high as 80 dBA. Noise levels above 110 dBA become intolerable and can result in hearing loss. Figure 1 shows sound levels for some common noise sources.

Environmental noise effects on human populations can include speech interference, sleep disturbance, and annoyance. The World Health Organization (WHO) has drafted a community noise guidelines document to document health effects of noise and recommend government actions to manage excessive noise exposure. This work may be reviewed at <http://www.nonoise.org/library/whonoise/whonoise.htm> (WHO, 1995).

Some land uses and activities are more sensitive to noise than others. Residential areas, schools, hospitals, churches, and parks are typical examples of noise-sensitive uses. Commercial land uses are generally less sensitive to noise, while industrial areas are often sources of noise. For this reason, most noise regulations include a variety of permissible noise levels that are based on the land use or zoning of both the location where the noise is produced and the location at which it is heard.

## **1.2 Vibration**

Vibration is the oscillatory motion of ground and buildings caused by events or activities such as earthquakes, vehicles traveling on highways and railroads, and the operation of construction equipment and machinery. Vibration is usually measured in terms of velocity. In the United States, inches per second is the measurement used to express vibration velocity. The root mean square (RMS) amplitude is used to describe the mean value of vibration amplitude; the RMS of a signal is the average of the squared amplitude of the signal. Thus, vibration measurements in this TM are described in units of “inches per second (in/sec), RMS velocity.”

Figure 2 provides information on typical levels of groundborne vibration. The human threshold of perception for vibration is approximately 0.0018 in/sec, and a level of 0.0056 in/sec is considered “distinctly perceptible.” Background vibration is generally 0.0003 in/sec; a typical bus or truck going over a bump could produce a vibration level of 0.0032 in/sec at a distance of 50 feet; vibration for bulldozers and other heavy tracked construction equipment could produce 0.0316 in/sec vibration at 50 feet.

## **1.3 Regulatory Environment**

State and local governments have primary responsibility for controlling the use of noise sources and regulating outdoor noise levels in the environment. The Washington Administrative Code (WAC 173-60-040) establishes noise level limits that vary according to the land use of the property where the noise source is located and the

property receiving the noise. These limits are administered by the Washington State Department of Ecology (Ecology). Ecology's maximum permissible sound levels are shown in Table 1. Treatment plant construction noise is exempt under WAC 173-60-050, Exemptions, where “sounds created by the installation or repair of essential utility service” are exempt during daytime hours from the maximum noise levels specified, but some local jurisdictions have more strict construction exempt time requirements.

**TABLE 1**  
Ecology Maximum Permissible Sound Levels

Land Use of Noise Source Property	Land Use of Receiving Property			
	Residential		Commercial	Industrial
	Day	Night <sup>a</sup>		
Residential	55	45	57	60
Commercial	57	47	60	65
Industrial	60	50	65	70

<sup>a</sup> Maximum permissible noise levels are 10 dBA lower than permissible daytime levels for residential receiving property between 10 p.m. and 7 a.m.

Source: WAC 173-60-040

Noise levels at the treatment plant sites would be regulated according to their respective jurisdictions: the City of Edmonds for the Unocal site, and Snohomish County for the Route 9 site.

### 1.3.1 Treatment Plant Sites

Noise resulting from activities on the Unocal site is regulated by the City of Edmonds Municipal Code, Title 5.30, Noise Abatement and Control, or by Title 17.60.010, Zoning Performance Standards. The Title 5.30 Code regulates noise according to the designated land uses of the property generating the noise and the property where the noise is heard. Residential properties that could receive noise from construction or operation of the treatment plant are considered “sensitive receivers.” The Title 17.60.010 Code regulates the noise level at the residential boundary during the night-time hours of 11:30 p.m. to 6 a.m., to 45 dBA. Other hours are allowed at noise levels up to 60 dBA in Title 17.60.010.

Permissible noise levels vary with time of day and activity (construction vs. operation). Permissible noise levels during daytime plant operation hours (defined as the period between 7 a.m. to 10 p.m.), as established by the City of Edmonds Municipal Code, Title 5.30, are summarized in Table 2. During night-time hours, between 10 p.m. and 7 a.m., maximum permissible sound levels are 10 dBA lower than during daytime hours. However, since the City of Edmonds Municipal Code, Title 17.60.010, has a lower night-time allowable level of 45 dBA, that code is considered most applicable to the treatment plant operations noise levels. In the City of Edmonds Municipal Code, Title 5.30, the applicable noise levels may be exceeded at any hour of the day or night by no more than 1.5 dBA for a total of 15 minutes during any 1-hour period, by 10 dBA for a total of 5 minutes in any 1-hour period, and by 15 dBA for a total of 1.5 minutes in any 1-hour

period. Construction noise is addressed in the Edmonds Municipal Code under Section 5.30.110 D of the noise code, where “sounds created by the installation or repair of essential utility service” are exempt during daytime hours from the maximum noise levels specified.

**TABLE 2**  
Edmonds Municipal Code Maximum Permissible Noise Levels (dBA)

<b>Land Use of Receiving Property</b>	<b>Land Use of Noise Source</b>		
	<b>Residential Day/Night</b>	<b>Business Day/Night</b>	<b>Commercial Day/Night</b>
Residential	55/45	57/47	60/50
Business	57/47	60/50	65/55
Commercial	60/50	65/55	70/60

Noise at the Route 9 site is regulated by the Snohomish County Code, Chapter 10.01. Acceptable noise levels during daytime hours (defined as the period between 7 a.m. to 10 p.m.) are shown in Table 3. During night-time hours (between 10 p.m. and 7 a.m.), the maximum permissible sound levels are 10 dBA lower than during daytime hours. The applicable noise levels may be exceeded at any hour of the day or night by no more than 5 dBA for a total of 15 minutes in any 1-hour period, by 10 dBA for a total of 5 minutes in any 1-hour period, or by 15 dBA for a total of 1.5 minutes in any 1-hour period.

Vibration that sources are allowed to generate are regulated by Edmonds Municipal Code, Title 17.60.010, Zoning Performance Standards, which regulates vibration at the boundary of the vibration source. This vibration requirement allows no more than 0.003-inch displacement over the frequency range of zero to 5,000-Hertz, as measured at any point on the boundary of the property from which the vibration is produced.

**TABLE 3**  
Snohomish County Code Maximum Permissible Noise Levels (dBA)

<b>Land Use of Receiving Property</b>	<b>Land Use of Noise Source</b>			
	<b>Rural Day/Night</b>	<b>Residential Day/Night</b>	<b>Commercial Day/Night</b>	<b>Industrial Day/Night</b>
Rural	49/39	52/42	55/45	57/47
Residential	52/42	55/45	57/47	60/50
Commercial	55/45	57/47	60/50	65/55
Industrial	57/47	60/50	65/55	70/60

Under the Snohomish County noise code, sounds created by construction equipment, including special construction vehicles, at temporary construction sites are exempt from maximum permissible noise levels if the receiving property is located in a commercial or industrial district. The exemption extends to residential receiving properties during daytime hours (7 a.m. to 10 p.m.). Sounds created by construction equipment at

temporary construction sites are exempt from the maximum noise levels at all receiving properties. However, if conditions applied to a project through the State Environmental Policy Act or conditional use permit process are more restrictive than the noise code, the more restrictive standards will apply.

Currently, there are no regulations governing the vibration that new or existing sources are allowed to generate at the Route 9 site. There are also no regulations governing vibration caused by construction activities at the Route 9 site.

## 1.4 Treatment Plant Sites

Following is a summary of existing noise and vibration conditions at the Unocal and Route 9 sites.

A noise evaluation was conducted at the treatment plant sites. Sound level monitoring equipment conforming to American National Standards Institute (ANSI) S1.4, Type 1 and Type 2, was used to gather and analyze noise levels. Microphones were calibrated at the beginning of each monitoring period and checked at the conclusion of monitoring.

Noise levels are measured and analyzed statistically to understand the range of levels and the frequency of occurrence of certain levels. Statistical variation in noise level is described by percentage exceedance levels, where the indicated  $L_n$  is the noise level exceeded a specific percentage of the time designated by the value of “n.” For example, the  $L_{50}$  noise level is that value observed to be exceeded 50 percent of the time and is considered to be the mean value of the noise level over a 1-hour monitoring interval. The hourly  $L_{50}$  noise level was measured at both the Unocal and Route 9 plant sites. The  $L_{50}$  is used as the interval mean value for comparison to “maximum permissible” levels specified in the codes. Each jurisdiction allows for specific sound level excesses for a limited number of minutes in any 1-hour period, which allows for a statistically variable sound level, such as what is experienced from normal ambient sources, including traffic and other common sources contributing to any outdoor setting’s noise level. The  $L_{25}$  metric is used to relate the ambient noise level to the allowable level for 15 minutes in any 1 hour,  $L_{8.3}$  for 5 minutes in any 1 hour, and  $L_{2.5}$  for 1.5 minutes in any 1 hour. The  $L_{2.5}$  was not monitored because no Brightwater project elements will be impulse-type operational sound sources, which could influence the  $L_{2.5}$  level.

Vibration was measured using an accelerometer, which feeds information about ground or building movement to a spectrum analyzer. The analyzer then produces information that can be used to determine the velocity of the vibration. For this project, vibration was monitored with a sound level meter conforming to ANSI S1.4, Type 1, using a calibrated vibration transducer (accelerometer) conforming to ISO 10012-1.

Table 4 defines groundborne vibration impact levels based on land use, and Table 5 indicates associated human perception of vibration levels. These data are excerpted from U.S. Department of Transportation (1998). Although the data are related to periodic vibration from transportation sources, the human perception levels described in Table 5 are relevant to both construction and operation vibration, and the “frequent event” levels of Table 4 can be compared to existing vibration levels for rating the existing conditions.

**TABLE 4**  
Groundborne Vibration Impact Criteria

Land Use Category	Groundborne Vibration Impact Levels (in/sec)	
	Frequent Events <sup>a</sup>	Infrequent Events <sup>b</sup>
<b>Category 1:</b> Buildings where vibration would interfere with interior operations, such as certain microelectronics manufacturing processes	0.0018	0.0018
<b>Category 2:</b> Residences and buildings where people normally sleep	0.004	0.010
<b>Category 3:</b> Institutional land uses with primarily daytime use such as schools and churches	0.0056	0.0141

<sup>a</sup> Frequent Events are defined as more than 70 vibration events per day.

<sup>b</sup> Infrequent Events are defined as fewer than 70 vibration events per day.

**TABLE 5**  
Human Response to Different Levels of Groundborne Vibration

RMS Vibration Velocity Level (in/sec)	Human Response
0.0018	Approximate threshold of perception for many humans.
0.0056	Approximate dividing line between barely perceptible and distinctly perceptible. Many people find train vibration at this level unacceptable.
0.0178	Vibration acceptable only if there are an infrequent number of events per day.

Category 2 land use as defined in Table 4 was chosen as the criterion applicable to residential receivers adjacent to both the Unocal and Route 9 sites. The vibration values indicate the maximum for a single event.

#### 1.4.1 Unocal Site

Three locations (NML-1 through NML-3), at the Unocal site were monitored for existing noise levels (Figure 3 illustrates the monitoring locations). Two of the locations (NML-1 and NML-3) were near the southwest and southeast corners of the site; the third (NML-2) was midway along the northwest side of the site, adjacent to the railroad tracks. Two locations were monitored for 24-hour periods on the weekdays of May 8 through May 9, 2002; the other location was monitored for 24 hours on the weekend days of May 11 and May 12, 2002, and on the weekdays of June 10 through June 12, 2002. Vibration levels were measured at two of the same locations monitored for noise. Vibration monitoring locations are shown as VML-1 and VML-2 in Figure 3. Existing noise and vibration conditions at the Unocal site are characterized as follows:

- The minimum hourly  $L_{50}$  noise level for all three monitoring locations was 32 dBA, which occurred during weekday night-time hours of 2 a.m. to 3 a.m. at noise monitoring location NML-2. The maximum hourly  $L_{50}$  was 48 dBA at NML-2 from

10 a.m. to 11 a.m. on a weekday. Minimum noise levels closer to Pine Street residences, NML-1, were 2 to 4 dBA higher than the minimum levels near Admiral Way, NML-2, because of wind in the trees.

- A minimum ambient ground vibration level measurement of 0.000009 in/sec, RMS velocity, was measured July 10 at the Fish Hatchery monitoring location, VML-2. A maximum ground vibration level of 0.008 in/sec, RMS velocity, was measured on Admiral Way, VML-1, while a freight train was passing. Table 4 data show that some residents near the Unocal site may sense vibration events from trains on Admiral Way.

### 1.4.2 Route 9 Site

Noise levels were recorded at two locations at the Route 9 site. These are shown as NML-1 and NML-2 in Figure 4. The two locations were monitored for 24-hour periods on weekdays from April 25 through April 26 and April 29 through April 30, 2002. Vibration levels were measured at the same location as NML-2; the vibration monitoring location is shown as VML-1 in Figure 4. The existing noise and vibration conditions at the Route 9 site can be characterized as follows:

- The minimum hourly  $L_{50}$  noise level for the two monitoring locations, 45 dBA, occurred during the weekday night-time hours of 2 a.m. to 3 a.m. at noise monitoring location NML-1. The maximum  $L_{50}$  noise level, 64 dBA, occurred at NML-1 from 9 p.m. to 10 p.m. on a weekday.
- A minimum ambient ground vibration level of 0.0000085 in/sec, RMS velocity, was measured July 10, 2002, at monitoring station VML-1. A maximum ground vibration level of 0.000025 in/sec, RMS velocity, was measured at this location while a heavy truck was passing on SR-522.

## 2 IMPACTS

### 2.1 Study Methodology

Noise and vibration impacts were estimated using the following methods:

- Selection of noise and vibration monitoring locations based on proximity to residential areas and that were representative of existing ambient night-time minimum and daytime maximum levels on residential land near the treatment plant sites.
- Identification of existing noise and vibration sources that would be modified or eliminated by the project elements when the project is constructed.
- Consideration of project-generated noise and vibration received at noise-sensitive properties.

Assumptions included the following:

- Construction noise and vibration will occur only during the time periods allowed by applicable codes or variances, or exemption permits will be sought to permit construction outside of permitted hours. If construction activities are permitted

outside of exempt time periods, noise levels will be required to meet the applicable code noise level limits for residential land use during the permitted hours. The applicable noise source land use is industrial for the Route 9 site and commercial for the Unocal site.

- Operating noise level limits will be achieved by mitigation of noise levels as part of the design of treatment plant facilities. Noise levels at the nearest residential land use boundary will not exceed regulated noise limits.

Noise field data for each monitoring location at each treatment plant site are presented in the attachment to this TM. The data show 24-hour periods of statistical noise levels, with maximum and minimum levels identified at the times they occurred. The statistical level spread indicates the variation in level due to intermittent sound events such as truck and auto traffic. Octave frequency band noise levels representing the minimum night-time noise level at each treatment plant site are also shown in the attachment to this TM, to record the ambient sound spectrum shape, which will be used for acoustic design and mitigation of treatment plant noise sources.

## 2.2 TREATMENT PLANT SITES

### 2.2.1 Construction Impacts

#### 2.2.1.1 Impacts Common to Both Sites

Noise generated by construction equipment would be experienced by nearby receptors while the treatment facilities are being built. Maximum noise levels from commonly used construction equipment at a distance of 50 feet are shown in Table 6.

**TABLE 6**  
Expected Construction Equipment and Maximum Noise Levels

Type of Equipment	Rating or Capacity	Engine Size (Horsepower)	Range of Maximum Sound Level at 50 feet (dBA)
Crawler tractor / dozer	101 to 250 hp	101 to 250	81 to 85
	251 to 700 hp	251 to 700	85 to 90
Front-end loader	2-1/4 to 5 cu. yd.	116 to 299	82 to 86
	6 to 15 cu. yd.	300 to 750	86 to 90
Hydraulic backhoe excavator	1-1/2 to 3 cu. yd.	131 to 335	82 to 86
	3-1/4 to 7 cu. yd.	336 to 760	86 to 90
Grader	9 to 16 ft. Blade	60 to 350	79 to 86
Mobile crane	11 to 75 ton at 10 ft. Boom	121 to 240	82 to 85
Pile driver (impact)	Not specified	Not specified	101
Pile driver (sonic or vibratory)	Not specified	Not specified	96

**TABLE 6**  
Expected Construction Equipment and Maximum Noise Levels

Type of Equipment	Rating or Capacity	Engine Size (Horsepower)	Range of Maximum Sound Level at 50 feet (dBA)
Portable air compressor	400 to 2,000 cfm at 100 psi	126 to 600	82 to 89
Trucks	100 to 400 hp	100 to 400	81 to 87

Source: Bolt, Beranek and Newman (1981).

At distances beyond 50 feet, these maximum noise levels would be reduced by 5 to 7 dBA for each doubling of the distance between the noise source and the receiver. For example, a hydraulic backhoe excavator of 7 cubic yard capacity and 760 horsepower could generate noise levels of 83 to 85 dBA at a distance of 100 feet. The actual noise reduction would depend on effects of terrain and line-of-sight barriers such as berms, retaining walls, opaque fences, and buildings.

Truck traffic during construction would also have the potential to cause increased noise levels at receptors along the construction access routes. Impacts specific to each site are discussed in the sections below.

The range of maximum sound levels at a distance of 50 feet from the various construction equipment exceeds regulated noise levels in all jurisdictions; however, as noted above in Section 1.3, Regulatory Environment, construction activities during daytime hours on weekdays are exempt from maximum noise levels in all jurisdictions within the project area. Traffic noise on public roads is also exempt from the maximum levels. However, King County has committed to measures that will reduce construction noise and minimize impacts on nearby residences and businesses. These measures are described below in Section 3.0, Mitigation Measures.

Some vibration would also occur as a result of heavy construction equipment operation. Table 7 shows representative levels of vibration likely to be experienced at a distance of 50 feet from each type of equipment. All of the vibration levels indicated in Table 7 are at or above the “residential annoyance” level for infrequent events, as shown in Figure 1, and are also at or above the single event maximum criteria level shown in Table 5 for residential structures subject to infrequent events. Noise and vibration levels are lower when sonic or vibratory-type pile driving equipment, rather than impact-type equipment, is used for construction.

### **2.2.1.2 Unocal Site**

Truck traffic and site work during construction at the Unocal site would result in temporary noise impacts to receptors near the site and along construction haul routes. The kinds of noise that might be expected during construction include the sounds of earth-moving equipment, pile-driving equipment, concrete trucks, dump trucks, cranes, and other types of heavy construction equipment. The nearest receptors to the Unocal site are residences near monitoring locations NML-1 and NML-3 (see Figure 3). The closest

**TABLE 7**  
Expected Construction Equipment and Maximum Vibration Levels

Type of Equipment		Approximate Vibration Level at 50 feet (in/sec) RMS
Pile driver (impact)	Upper range	0.200
	Typical	0.080
Pile driver (Sonic or vibratory)	Upper range	0.090
	Typical	0.022
Large bulldozer		0.011
Loaded trucks		0.010

residence is approximately 130 feet south of NML-1. At a distance of 50 feet, construction trucks can result in maximum noise levels of 81 to 87 dBA, and other types of equipment can result in levels of up to 90 dBA at this distance. Maximum noise levels shown in Table 6 would be reduced 5 to 7 dBA per doubling of distance beyond 50 feet or would be increased 5 to 7 dBA per halving of distance from the base 50 feet; thus, noise levels at the nearest residences are likely to be a maximum of 81 to 83 dBA.

Calculation example:

$$90 \text{ dBA source at 50 feet} + 20 * \text{Log}_{10} (50 \text{ feet} / 130 \text{ feet}) = 82 \text{ dBA}$$

Noise level reduction with distance could be greater, depending on the effects of terrain and line-of-sight barriers such as berms, retaining walls, and buildings. The 82 dBA estimated maximum level is 23 dBA greater than the maximum ambient  $L_{10}$  at Unocal NML-1 or NML-3 (59 dBA) during the exempt construction hours of 7 a.m. to 10 p.m. The  $L_{10}$  is selected as the appropriate comparative statistical noise level measure for variable sources such as mobile construction equipment under varying load. A 23-dBA increase in peak noise levels to 82 dBA outdoors during daytime hours would be a significant impact, similar to a busy urban daytime environment.

Other land uses adjacent to the Unocal treatment plant site include the marina and port properties (commercial waterfront) to the west and a public park, east of the site. Buildings on the commercial waterfront zone could be within 200-feet of treatment plant construction and could be subject to maximum exterior noise levels of 78 dBA. The public park land is approximately 600-feet from treatment plant site construction and could be subject to maximum noise levels of 68 dBA. The expected construction noise levels would be significantly above the existing daytime ambient noise levels (48 dBA,  $L_{50}$ ), and could be audible inside buildings on the commercial waterfront. Although maximum noise levels outside of marina and port buildings may be distracting and interfere with normal verbal communication, noise levels inside of buildings are not likely to affect communication or the commercial office use of those buildings. Maximum noise levels at the public park could discourage people from using the park, but maximum construction noise levels are intermittent and could be deemed acceptable by park users.

### **2.2.1.3 Route 9 Site**

Truck traffic and site work during construction at the Route 9 site would result in temporary noise impacts to receptors near the site and along construction haul routes. The kinds of noise that might be expected during construction are similar to those described for the Unocal site. Sensitive residential receptors are located both east and west of the Route 9 site. The nearest residences to the east of the site are approximately 700 feet east of the property line and are separated from the site by SR-522 and the Burlington Northern-Santa Fe tracks. The closest residences to the west are approximately 100 feet west of the property line, across SR 9. Construction noise levels at the nearest residences west of the site are likely to be a maximum of 83 to 85 dBA.

Calculation example:

$$90 \text{ dBA source at 50 feet} + 20 * \text{Log}_{10} (50 \text{ feet} / 100 \text{ feet}) = 84 \text{ dBA}$$

Noise level reduction with distance could be greater, depending on the effects of terrain and line-of-sight barriers such as berms, retaining walls, and buildings. The 84 dBA estimated maximum level is 17 dBA greater than the maximum ambient  $L_{10}$  at Route 9 NML-1 or NML-2 (67 dBA) during the exempt construction hours of 7 a.m. to 10 p.m. The  $L_{10}$  is selected as the appropriate comparative statistical noise level measure for variable sources such as mobile construction equipment under varying load. A 17-dBA increase in peak noise levels to 84 dBA outdoors during daytime hours would be a significant impact, similar to a busy urban daytime environment. Residences to the east of the site would not be impacted during daytime hours due to greater distance and noise from SR 522.

## **2.2.2 Operational Impacts**

### **2.2.2.1 Impacts Common to Both Sites**

The following types of operational noise are associated with treatment facilities and/or pump stations:

- Noise from the operation of mechanical equipment, including pumps, blowers, fans, centrifuges, and cogeneration engine or turbine generators
- Noise from standby electrical generation equipment (e.g., backup generators for treatment facilities or pump stations during a power outage)
- Noise from electrical power substations
- Noise from water flowing over weirs

The potential for these types of impacts is discussed below for the treatment plant sites.

Vibration can occur from the operation of mechanical equipment at treatment facilities and pump stations. Based on the U.S. Department of Transportation (1998), a vibration velocity of 0.004 in/sec, RMS (applicable to a Category 2 land use in Table 4), was chosen as the maximum acceptable vibration level applicable to residential receivers adjacent to both the Unocal and Route 9 sites. Most types and sizes of mechanical equipment that will be used during operation of the Brightwater treatment facilities are not capable of generating vibration at high enough levels to be detected at sensitive

properties. Large (150 horsepower and larger) pumps, blowers, centrifuges, fans, and engine generators will be designed with the necessary vibration isolation and damping foundations to reduce transmission of force to the supporting structures to levels below the threshold of human perception at the nearest residences.

#### **2.2.2.2 Unocal Site**

During daytime hours (7 a.m. to 10 p.m.), treatment plant operations are not expected to result in an increase in existing noise levels at the nearest residential receptors to the Unocal site (residences near the Woodway and Fish Hatchery noise monitoring locations NML-1 and NML-3). Night-time operational noise could increase the existing minimum noise levels at these receptors by 5 dBA, which is a perceptible increase to most people and a minor impact. However, the higher noise level still would not exceed the regulated levels applicable to residential land use from any land use sources under the City of Edmonds Municipal Code, Title 17.60.010, Zoning Performance Standards, which sets a maximum of 45 dBA during the night-time hours of 11:30 p.m. to 6 a.m. Treatment plant noise sources with tonal qualities, such as engines, fans, and blowers, will be designed with noise reductions in the appropriate frequency bands to reduce tonal components of the spectrum to limited levels over the existing minimum hour ambient noise levels in the same frequency band as the tonal source. This will result in very low contribution of tonal sources to the overall noise level and difficulty in discerning the tone, even during the quietest night-time periods. For additional discussion of measures to reduce noise levels, refer to Section 3.0, Mitigation Measures.

Truck traffic resulting from chemical or other deliveries to the plant or hauling biosolids, grit, or screenings from the plant would impact residences along Pine Street. The impacts should be minimal because of existing posted speed limits, but would intermittently be noticeable to the residences along Pine Street.

##### **2.2.2.2.1 Unocal 72-mgd Sub-Alternative**

Noise impacts from the 72-million-gallons-per-day (mgd) facility would be only slightly greater than from the 54-mgd facility, because of the increased number of process units and energy input. The additional contributing noise sources would be minor and farther from the residential receptors than the initial phase process equipment and, therefore, likely would not impact offsite receptors.

##### **2.2.2.2.2 Unocal Structural Lid Sub-Alternative**

Noise impacts of a lidded facility would depend in large part on the type of land use developed on the lid. The lid structure would tend to attenuate plant noise sources during night-time hours. Development of the lid use could generate significant noise levels, possibly during the quiet night-time hours.

#### **2.2.2.3 Route 9 Site**

The noise generated by plant operations at the nearest residential receptor to the Route 9 site would be no more than that allowed by the Snohomish County Code for the minimum night-time period, which is 47 dBA at residential land use receiving property in rural zones, with the treatment plant land use being industrial (see Table 3). The existing measured minimum night-time ambient noise level is 45 dBA. This is less than the 47 dBA Snohomish County Code threshold by 2 dBA. Night-time operational noise could

increase the existing minimum noise levels at the nearest residential land use by 2 dBA, which may be a perceptible increase to some people and a minor impact.

Treatment plant noise would be masked by traffic noise from SR-522 and SR 9 much of the time. Although the change in noise levels may be perceptible under night-time conditions, treatment plant noise sources with tonal qualities, such as engines, fans, and blowers, will be designed with noise reductions in the appropriate frequency bands to reduce tonal components of the spectrum to limited levels over the existing minimum hour ambient noise levels in the same frequency band as the tonal source. This will result in very low contributions of tonal sources to the overall noise level and difficulty in discerning the tone, even during the quietest night-time periods. Refer to Section 3.0, Mitigation Measures, for additional discussion of measures to reduce noise levels.

Truck traffic resulting from chemical or other deliveries to the plant or hauling biosolids, grit, or screenings from the plant would intermittently be perceptible by residences along SR 9 from the plant exit to the interchange at SR-522. Operational truck noise impacts are expected to be minimal at posted speed limits, and would be intermittently noticeable by the residences along SR 9.

### **2.3 No Action Alternative**

Noise levels would remain unchanged as a result of implementation of the No Action Alternative. There would be no construction or operation of the treatment plant and existing noise levels would remain the same in the area, or increase, depending on the development that eventually occurs on the sites.

### **2.4 Cumulative Impacts**

If construction of the Brightwater Treatment Plant at the Unocal site were to take place at the same time as construction of the Edmonds Crossing multimodal facility, cumulative noise from the two projects would be higher at nearby receptors than at either facility alone. Noise levels during operation of the two facilities would also be higher, primarily as a result of multimodal traffic using the Edmonds Crossing facility. However, the Edmonds Crossing facility is a public transportation element, and is not regulated for noise levels. Related traffic noise impacts are therefore considered separately from the treatment plant. The treatment plant regulated noise level limits are specified without any credit or debit from other noise sources not in the control of the treatment plant. The treatment plant operational noise design criteria for the Unocal site is below regulated limits because of the existing minimum hour low-level ambient noise at that site, and because the lid would reduce noise from the process units below.

## **3 MITIGATION MEASURES**

### **3.1 Treatment Plant Sites**

Mitigation measures to reduce noise impacts, in addition to applicable local regulations, have been identified for implementation at the treatment plant sites. The following measures would be implemented at either site.

### **3.1.1 Construction**

- All construction equipment would be required to be equipped with well-maintained mufflers and other sound control devices equal to or better performing than those originally supplied by the manufacturer.
- Noisy portable equipment, such as generators and compressors, would be located as far away from residential receptors as practical and muffled within enclosures.
- Equipment would not be allowed to idle for long periods of time; equipment not being used would be shut off.
- Construction haul routes would be designated to minimize impacts on residential receptors.
- Specific noise level limits would be specified in construction contract documents for certain construction equipment, such as internal combustion engine-powered generators, compressors, excavators, loaders, and graders.
- Any construction activities required outside of exempt daytime hours can only be conducted under an exemption permit or variance. If an exemption permit or variance is granted for night-time construction activities, the noise level limits for residential land use during night-time hours will be applied. Applicable noise source land uses are industrial for the Route 9 site and commercial for the Unocal site.
- Ambient-sensitive warning horns would be used to limit horn sound level over ambient level, or strobe light type warning devices would be used.
- Damping material would be used on material haul truck beds.

Sonic or vibratory-type pile driving is the only practical mitigation available for pile driving and could reduce transmitted vibration to at least half of the levels resulting from impact pile driving according to the U.S. Department of Transportation (1998). Other construction activities with vibration impacts, such as excavation and truck movement, will have lower impacts than pile driving and can only be partially mitigated by limiting the time of day of occurrences and the proximity to sensitive structures on residential land uses.

### **3.1.2 Operational**

Stationary process equipment noise levels are more difficult to specify than construction equipment noise levels in the EIS phase because process equipment noise levels are based on empirical calculations or provided by the equipment manufacturers. Whether calculated or provided by a manufacturer, specific capacity and rating parameters are required to determine the noise level. At this early phase of project development, equipment has not been selected nor sized to a level of detail adequate to support a calculated or vendor-supplied noise level. Further, the equipment is generally housed within structures and noise reductions for those structures will be controlled by application of architectural and mechanical features to the degree required to meet the design criteria. Process equipment noise level data used for design and specifications will be more detailed than for construction equipment by including the frequency spectrum distribution of noise levels. This is needed for control of tonal sources. The following

general mitigation measures would be implemented for treatment plant operation at either site.

- The treatment plant would be designed to operate at noise levels below the applicable regulated night-time noise levels of the respective jurisdictions at the nearest noise-sensitive receptor or designed to not exceed minimum existing ambient noise levels by more than 5 dBA, whichever is lower: 39 dBA at the Unocal site, and 47 dBA at the Route 9 site.
- All equipment would be housed in buildings and in below-ground galleries. Water fall sound would be confined to covered structures such that this low-level sound cannot contribute to the exterior noise level.
- Ventilation air intakes and exhausts of equipment rooms would be placed in a direction facing away from sensitive receivers whenever possible. Noise reduction rated acoustic louvers and duct silencers would be selected to reduce transmission of indoor noise to the outdoors.
- Noise sources with tonal qualities, such as engines, turbines, fans, and blowers, would be designed with noise reductions in the appropriate frequency bands to reduce tonal components of the spectrum to limited levels over the existing minimum hour ambient noise levels in the same frequency band as the tonal source. This would result in very low contribution of tonal sources to the overall noise level and difficulty in discerning the tone, even during the quietest night-time periods. Octave frequency band noise levels, representative of each treatment plant site's minimum hour ambient noise level, are shown in the Attachment to this Technical Memorandum. The existing night-time ambient spectrum shape would be preserved as much as possible with the overlay of treatment plant operational noise.
- Influent and effluent pump station ventilation systems design would include attenuation of fan noise and pump and motor noise to meet the specified noise level limits.

Specific noise sources expected to contribute to operational noise at either treatment plant site are itemized in Table 8. Noise reduction technology to be applied is also identified.

**TABLE 8**  
Major Treatment Process Equipment and Noise Mitigation

Noise Source	Unit Size (horsepower, unless otherwise noted)	Number of Units Operating at Build-Out (Ave. Flow)	Noise Reduction Methods
Unocal Site Influent Pumps	1,500	10	<ul style="list-style-type: none"> <li>• Motor room absorptive surface treatments</li> <li>• Acoustic louvers</li> <li>• Ventilation duct silencers</li> </ul>
Route 9 Site Influent Pumps	1,500	7	<ul style="list-style-type: none"> <li>• Motor room absorptive surface treatments</li> <li>• Acoustic louvers</li> <li>• Ventilation duct silencers</li> </ul>

**TABLE 8**  
Major Treatment Process Equipment and Noise Mitigation

Noise Source	Unit Size (horsepower, unless otherwise noted)	Number of Units Operating at Build-Out (Ave. Flow)	Noise Reduction Methods
Unocal Site Effluent Pumps	900	7	<ul style="list-style-type: none"> <li>• Motor room absorptive surface treatments</li> <li>• Acoustic louvers</li> <li>• Ventilation duct silencers</li> </ul>
Route 9 Site Effluent Pumps	NA	0	Not required
Either Site Aeration Blowers	500	8	<ul style="list-style-type: none"> <li>• Blower room absorptive surface treatments</li> <li>• Acoustic louvers</li> <li>• Ventilation duct silencers</li> <li>• Blower inlet silencers</li> <li>• Blower vent silencers</li> </ul>
Either Site Membrane Air Scour Blowers	500	5	<ul style="list-style-type: none"> <li>• Blower room absorptive surface treatments</li> <li>• Acoustic louvers</li> <li>• Ventilation duct silencers</li> <li>• Blower inlet silencers</li> <li>• Blower vent silencers</li> </ul>
Either Site Membrane Basin Lift Pumps	250	4	<ul style="list-style-type: none"> <li>• Pump room absorptive surface treatments</li> <li>• Acoustic louvers</li> <li>• Ventilation duct silencers</li> </ul>
Unocal Site Reuse Product Water Pumps	800	8	<ul style="list-style-type: none"> <li>• Pump room absorptive surface treatments</li> <li>• Acoustic louvers</li> <li>• Ventilation duct silencers</li> </ul>
Route 9 Site Reuse Product Water Pumps	400	10	<ul style="list-style-type: none"> <li>• Pump room absorptive surface treatments</li> <li>• Acoustic louvers</li> <li>• Ventilation duct silencers</li> </ul>
Either Site Dewatering Centrifuges	150	4	<ul style="list-style-type: none"> <li>• Centrifuge room absorptive surface treatments</li> <li>• Acoustic louvers</li> <li>• Ventilation duct silencers</li> </ul>
Either Site Cogeneration Engine or Turbine Generators	1,000 kW	2	<ul style="list-style-type: none"> <li>• Engine room absorptive surface treatments</li> <li>• Acoustic louvers</li> <li>• Ventilation duct silencers</li> <li>• Residential grade or better exhaust silencers</li> </ul>
Either Site Odor Control Exhaust Fans	200	18	<ul style="list-style-type: none"> <li>• Fan room absorptive surface treatments</li> <li>• Acoustic louvers</li> <li>• Ventilation duct silencers</li> <li>• Sound rated fan selection and specification</li> <li>• Fan duct silencers</li> </ul>

## **4      SIGNIFICANT UNAVOIDABLE ADVERSE IMPACTS**

Construction activities at the treatment plant site would cause unavoidable temporary increases in noise levels near the sites and along haul routes because of the limitations of practical mitigation. As discussed in the impacts section (Section 2) for the treatment plant sites, these impacts may be significant due to proximity to sensitive land use, particularly during peak construction periods.

## **5      REFERENCES**

Bolt, Beranek and Newman. 1981. *Noise Control for Buildings and Manufacturing Plants*. Bolt, Beranek and Newman, Inc., Cambridge, MA.

U.S. Department of Transportation. 1998. *High-speed Ground Transportation Noise and Vibration Impact Assessment*. Federal Railroad Administration, Office of Railroad Development. December 1998.

World Health Organization (WHO). 1995. *Community Noise*. Berglund, Birgitta, and Thomas Lindvall, eds. Access at <http://www.nonoise.org/library/whonoise/whonoise.htm>. Archives of the Center for Sensory Research. Stockholm, Sweden. 2(1), 1–195.

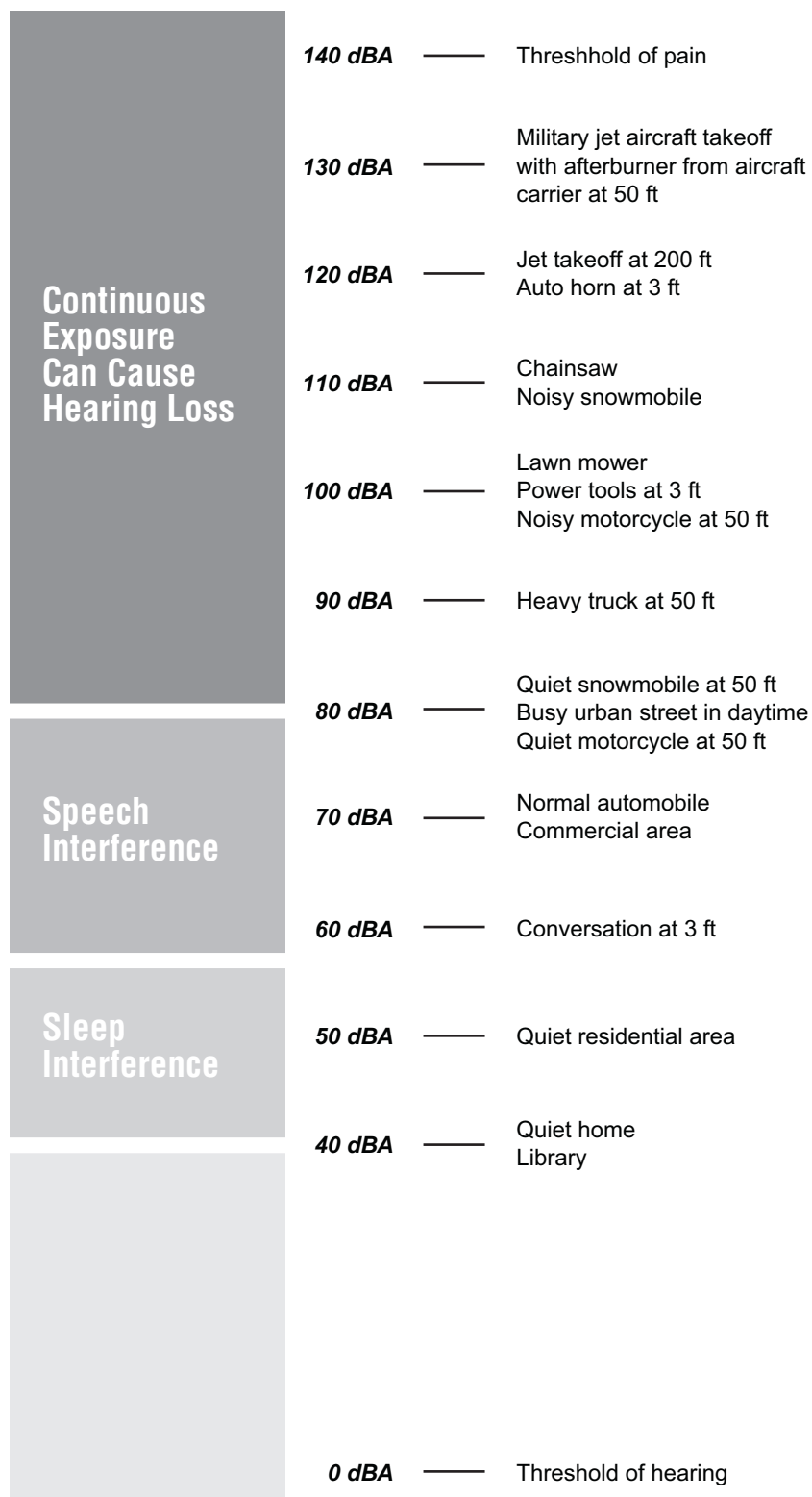


Figure 1  
**Typical Sound Levels**

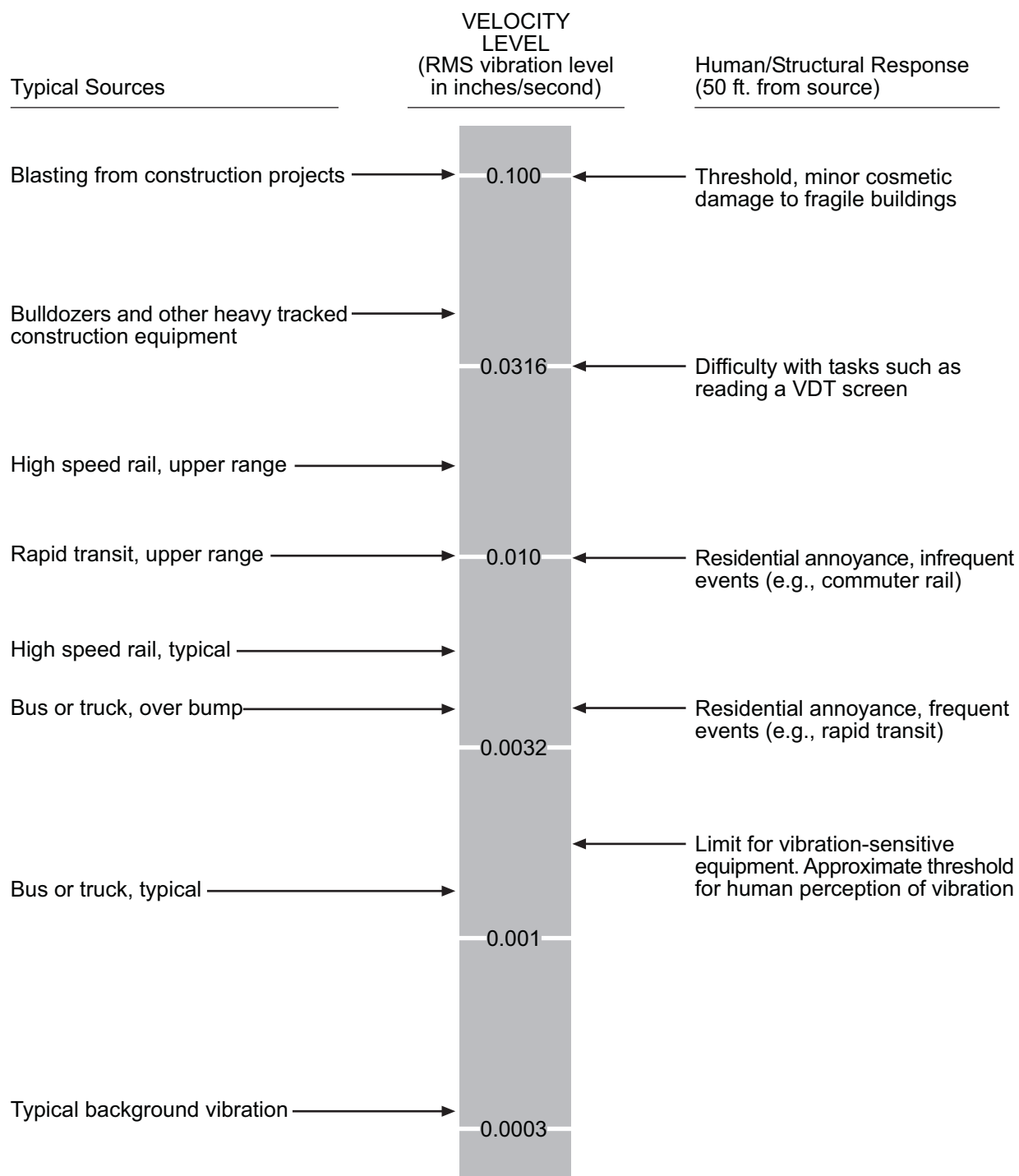


Figure 2

## Typical Levels of Ground-Borne Vibration



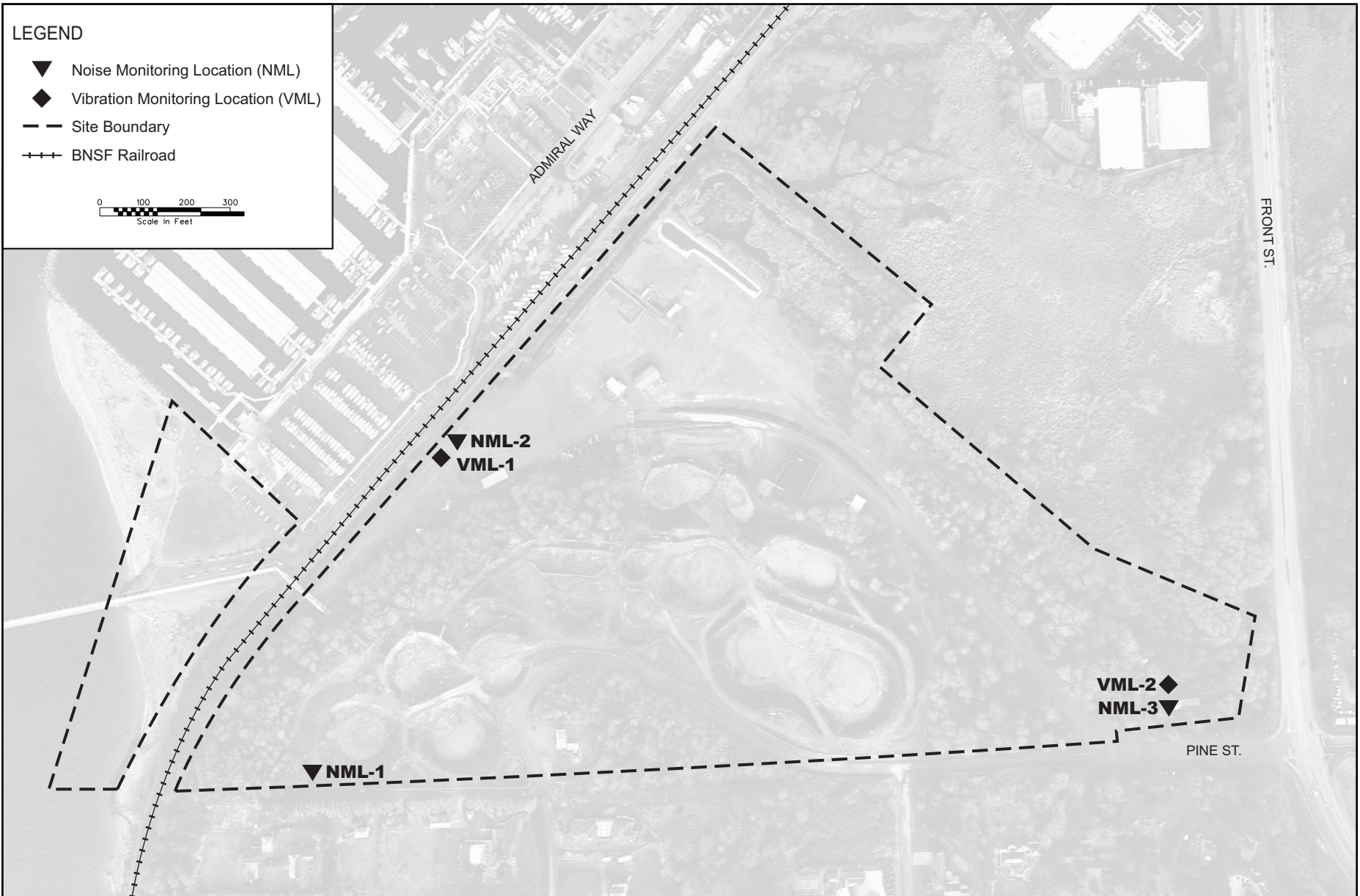
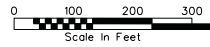
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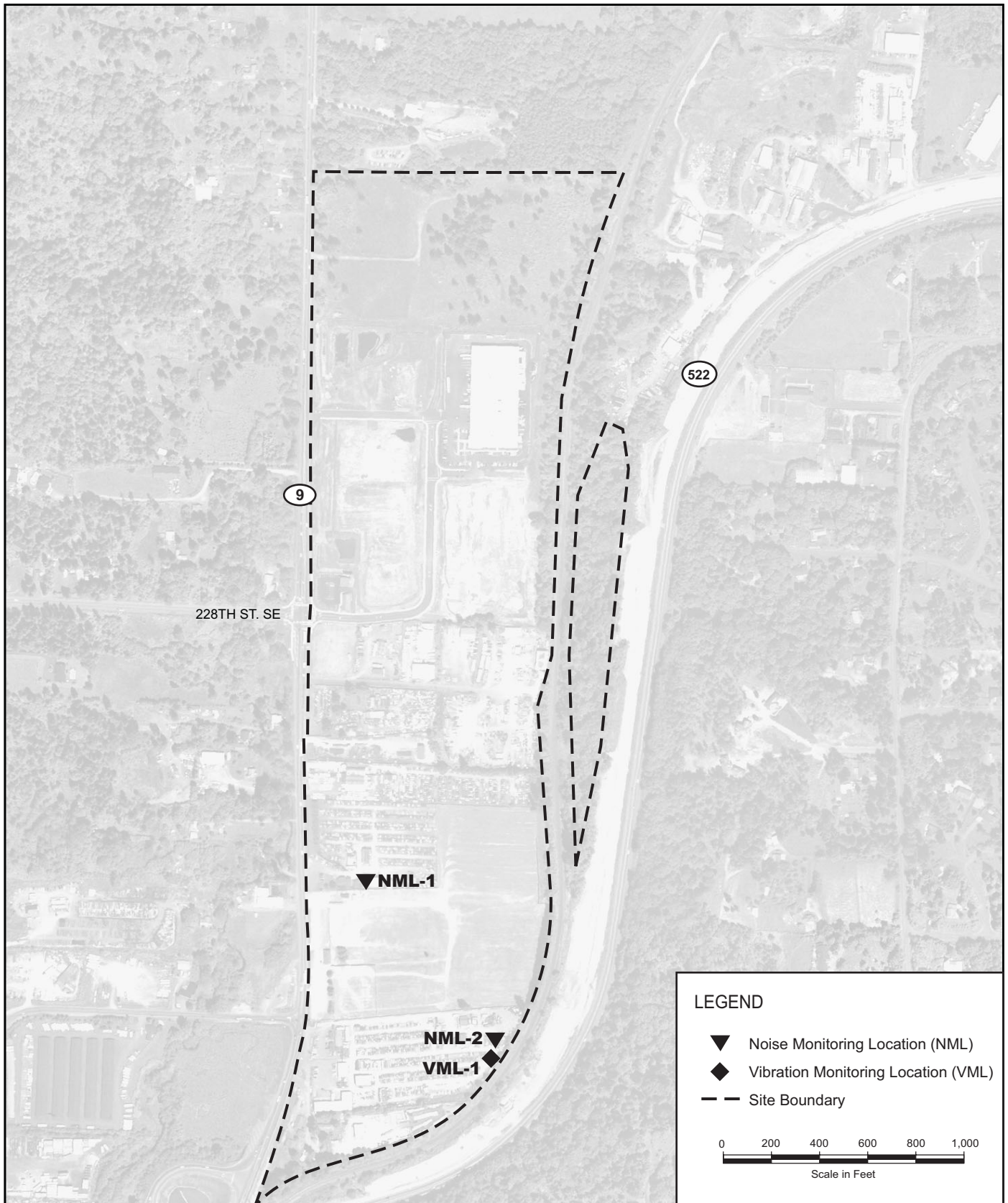
Data Sources: U.S. Department of Transportation, 1998  
Prepared by: CH2M HILL  
File Name: 176493.03.06\_W052003009SEA\_Noise\_F2\_typ\_levels\_  
ground-borne\_vibration\_7/21/03\_lw/gr

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

# LEGEND

- ▼ Noise Monitoring Location (NML)
- ◆ Vibration Monitoring Location (VML)
- - - Site Boundary
- + + + BNSF Railroad





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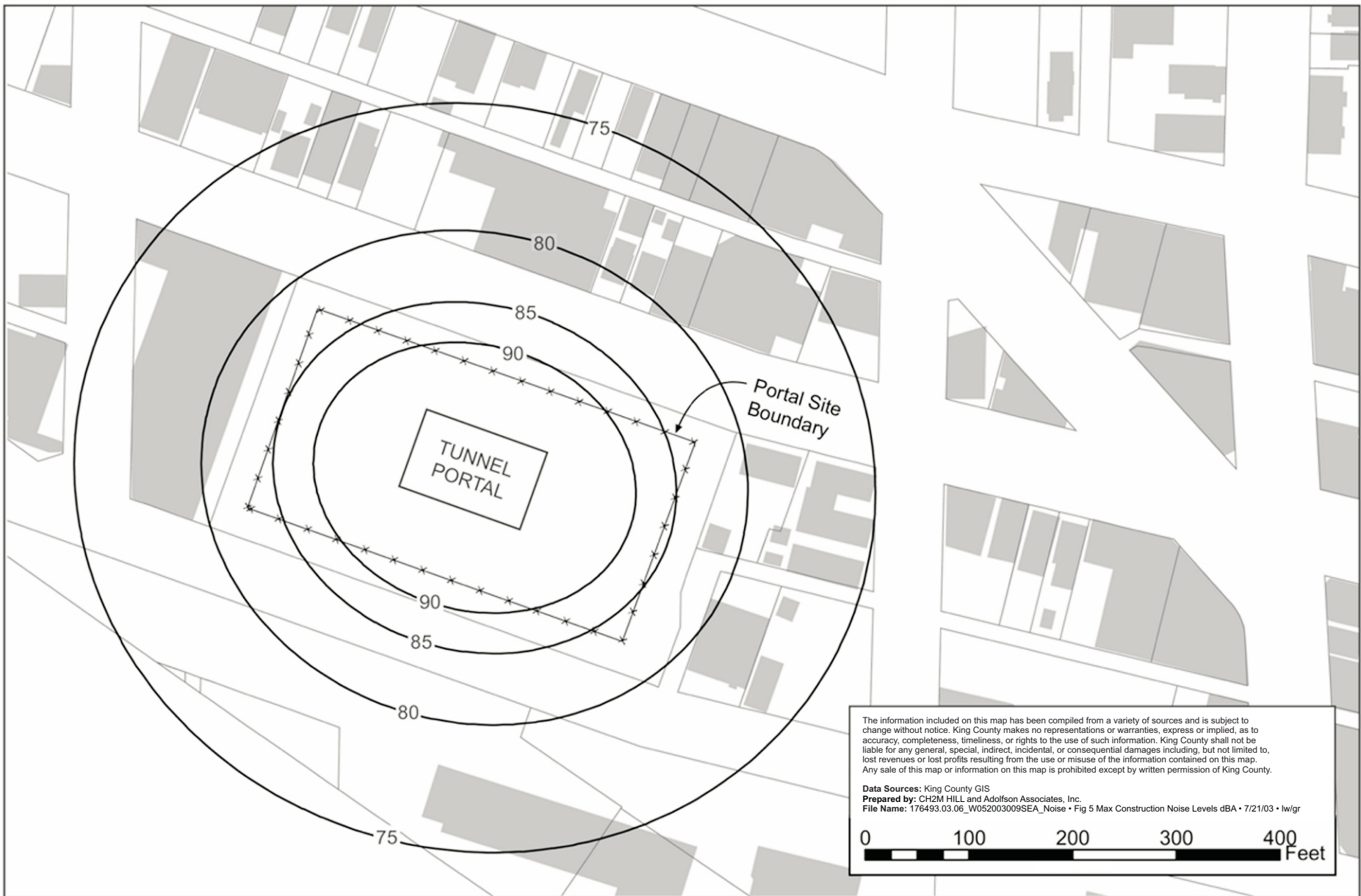
The information included on this map has been compiled from a variety of sources and is subject to change without notice. King County makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. King County shall not be liable for any general, special, indirect, incidental, or consequential damages including, but not limited to, lost revenues or lost profits resulting from the use or misuse of the information contained on this map. Any sale of this map or information on this map is prohibited except by written permission of King County.

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File Name: 176493.03.06\_W052003009SEA\_Noise • Fig 4 noise\_vibration\_monitoring\_locations\_rt9 • 7/21/03 • lwjlr



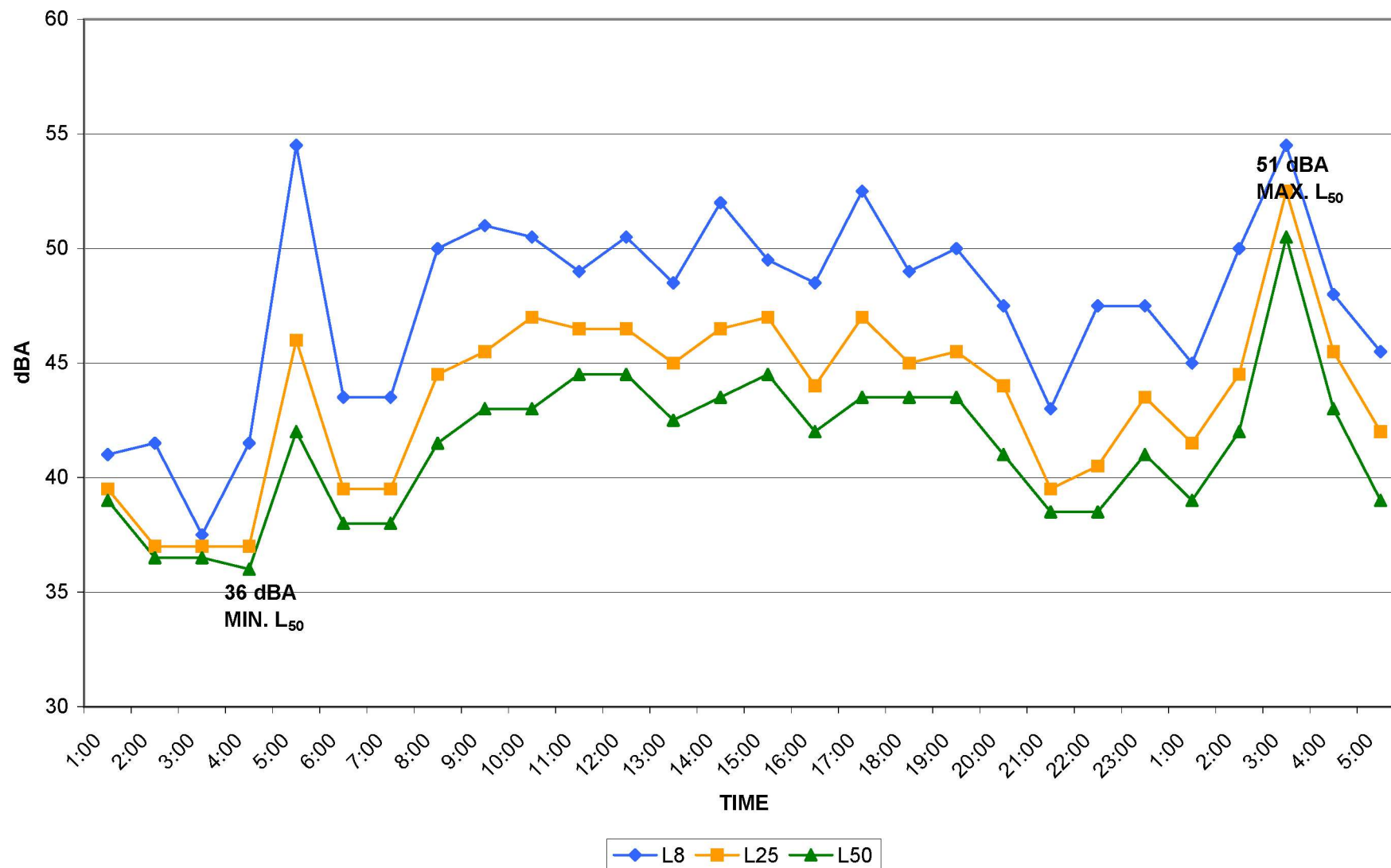
Figure 4  
**Noise and Vibration  
Monitoring Locations  
Route 9 Site**

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM



## **ATTACHMENT**

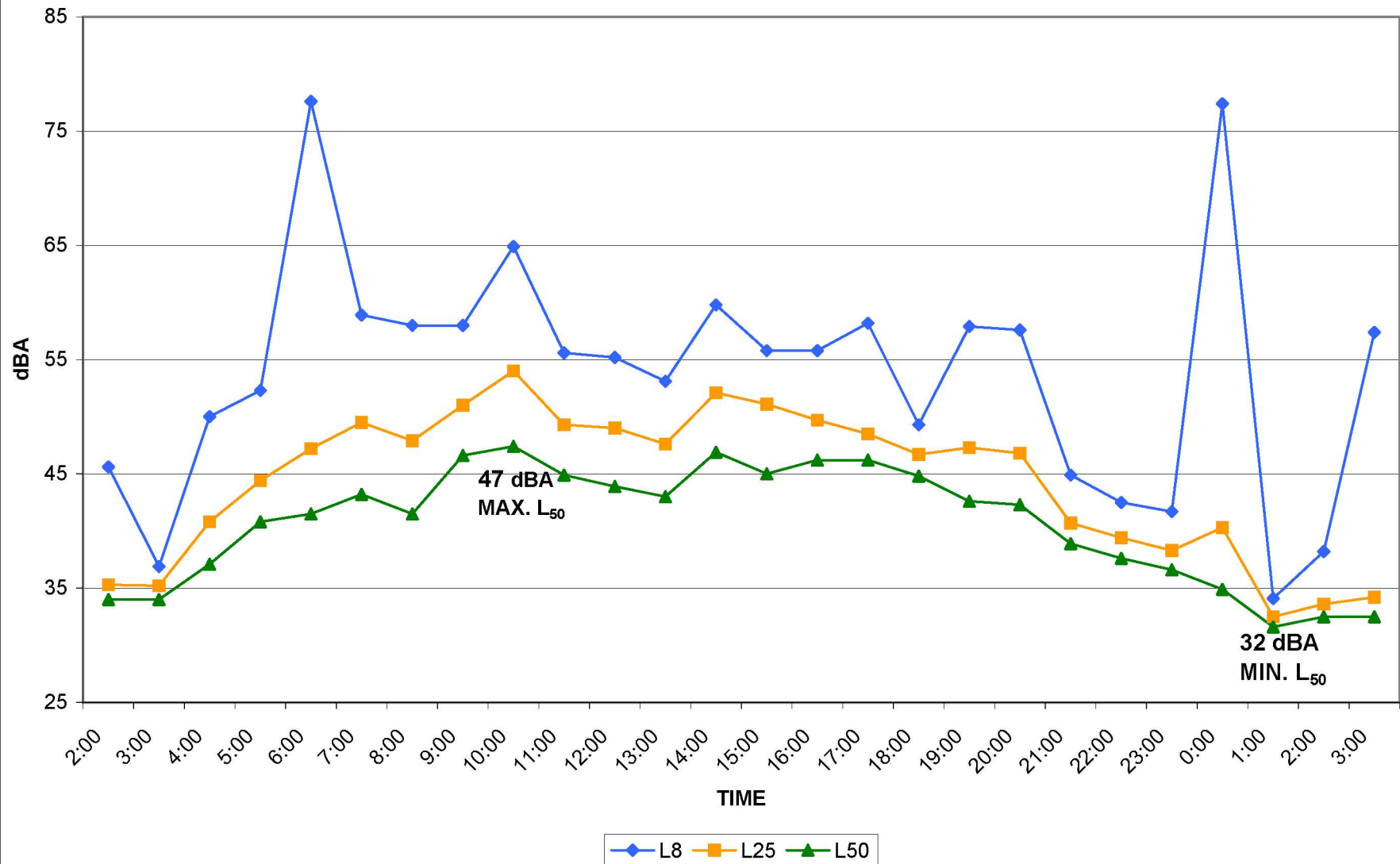
### **Noise Field Data for Treatment Plant Sites**



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**Wastewater Treatment  
Division**

Prepared by: CH2MHILL  
File Name: 157689.PE.EP.33\_W072003002SEA • NOISE • Appendix\_NML1 Woodway\_v2 • 10/21/02 • gm/mm

**NML-1**  
**Unocal – Woodway**  
**BRIGHTWATER FINAL EIS**



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 Division**

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 File Name: 157689.PE.EP.33\_W072003002SEA • NOISE • Appendix\_NML2\_Unocal\_Admiral Way\_v3 • 10/21/02 • gr/gm/mm

**NML-2**  
**Admiral Way – Unocal**  
**BRIGHTWATER FINAL EIS**

